Determining Effective Research Training Practices: A MARC U-STAR Case Study

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BACKGROUND

To diversify the scientific workforce NIGMS offers the MARC U-STAR (T34) training program to "assist undergraduate institutions to increase the number of well-prepared underrepresented students who matriculate into competitive/research active Ph.D. or combined M.D.-Ph.D. programs in the biomedical sciences, go on to research careers and will be available to participate in NIH-funded research." Various training activities (authentic research training, academic and skills development, etc.) are employed by MARC U-STAR institutions; however it is unclear which activities confer student persistence. Here, we examine if there is a **correlation between specific training activities and MARC U-STAR institutions that have strong track records of sending their graduates on to biomedical Ph.D. programs** ("High PhD Senders") from those that do not ("The Rest").

METHOD

- The text-mining tool, IN-SPIRE™ Visual Document Analysis, was used to search MARC applications (T34 activity code) of awarded grants in 2014.
- Using QVR, Type 1 and Type 2 MARC applications over the previous five years (2009-2014) produced 66 records for this analysis.
- Two parts of MARC applications contain relevant information, the 'Background' and 'Program Plan' sections.
- PDF files were extracted and run through code to get the Background and Program Plan sections as separate .txt files. The software produced 62 Background .txt and 64 Program Plan .txt files.*
- The .txt files for the Background and Program Plan sections were loaded into IN-SPIRE.
- Due to the small number of grants in the analysis, no informative clusters were found using the IN-SPIRE clustering tool.
- Analysis was carried out using networks to search for key training activity terms in both the Background and Program Plan sections.
- Data was exported to Excel to produce charts.
- Identify of MARC "High Ph.D. Sender" institutions was determined using Table D. MARC Trainee Outcomes from T2 Applications.

** The difference is due to missing/alternate section headings resulting in missing/blank output.*

DATA

MARC U-STAR Institutions: "High Ph.D. Senders"
(taken from T2 MARC Applications Table D)

MARC Institution	Institution Type	Reporting Period 2001-2005 (where applicable)*	# MARC Students who earned BS/BA Degree	#MARC Alumni who enrolled in PhD or MD-PhD	% of MARC Alumni who enrolled in PhD or MD-PhD	Outcome
1	HBCU	2001-2005	19	18	95%	"High Ph.D. Senders"
2	HSI	2001-2005	38	34	95%	
3	HSI	2001-2005	94	71	76%	
4	HSI	2002-2006*	37	28	76%	
5	HBCU	2002-2006*	37	28	76%	
6	RII	2001-2005	23	17	74%	
7	MSI	2001-2006*	39	28	72%	
8	HSI	2004-2007*	25	18	72%	
9	HBCU	2004-2007*	17	12	71%	
10	HBCU	2004-2007*	10	7	70%	
11	HSI	2001-2005	27	19	70%	
12	AANAPISI	2001-2005	17	11	65%	
13	AANAPISI	2003-2007*	23	14	61%	
MARC FOA expects >50% to enter PhD programs, those ≥ 60% considered "High PhD Senders"						

MARC U-STAR Funding Opportunity Announcement and Website

PAR-13-205: http://grants.nih.gov/grants/guide/pa-files/PAR-13-205.html
http://www.nigms.nih.gov/Training/MARC/Pages/USTARAwards.aspx

DATA

Key Training Activity Terms Searched
(taken from MARC U-STAR FOA)

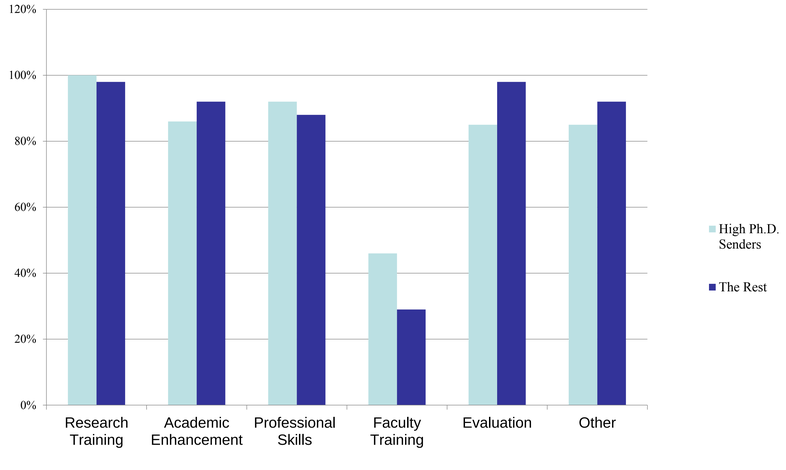
Research Training	**60**
faculty mentors	63
research classroom	24
research-based	7
summer research training	21
present research findings	12
research mentors	52
mentored research	19
Ph.D. programs	38
Professional Skills Development	**37**
career guidance	7
service-learning	14
time management OR stress management	29
implicit bias	1
stereotype threat	4
identity as a scientist	0
individual development plans	4
diversity OR inclusion	52
Faculty Training	**5**
faculty training	4
modalities	3
pedagogical OR pedagogy	19
Evaluation	**55**
feedback	53
career development	23
evaluation	60
Academic Enhancement	**55**
academic preparation	15
academic integration OR social integration	6
knowledge development OR skill development	8
supplemental instruction	14
experimental design	21
interdisciplinary learning	1
cross-disciplinary	2
active learning	9
inquiry-based	14
problem-based	8
group assignments	4
critical thinking	45
problem-solving	28
conduct research	25
responsible conduct of research	43
Other	**44**
program goal	35
student publications	6
student presentations	19
recruitment criteria	1
selection criteria	13
retention strategies	2
financial support	24
pipeline	34

Note:
- *Group headings are the number of grants with two or more matches to key words in that section.*
- *Numbers are the number of grants with matches in the Program Plan section only.*

RESULTS

- References to MARC activities are much more prevalent in the "Program Plan" section of the application than the "Background" sections. Only the "Program Plan" section was thereby used in the analysis.

Proportion of 'Program Plan' Sections containing Key MARC Training Activity Terms



RESULTS

Detailed Activities found in "Program Plan" Section

	Counts			Percentages		
	All MARC grants 2014	High Ph.D. Sender	The Rest (not high Ph.D.)	All MARC grants 2014	High Ph.D. Sender	The Rest (not high Ph.D.)
All MARC Grants 2014	**64**	**13**	**51**	**64**	**13**	**51**
Research Training	**60**	**13**	**50**	***94%***	***100%***	***98%***
faculty mentors	63	13	50	*98%*	*100%*	*98%*
research classroom	24	5	19	*38%*	*38%*	*37%*
research-based	7	2	5	*11%*	*15%*	*10%*
summer research training	21	2	19	*33%*	*15%*	*37%*
present research findings	12	1	11	*19%*	*8%*	*22%*
research mentors	52	11	41	*81%*	*85%*	*80%*
mentored research	19	3	16	*30%*	*23%*	*31%*
Ph.D. programs	38	7	31	*59%*	*54%*	*61%*
Academic Enhancement	**55**	**12**	**50**	***86%***	***92%***	***98%***
academic preparation	15	3	12	*23%*	*23%*	*24%*
academic integration OR social integration	6	1	5	*9%*	*8%*	*10%*
knowledge development OR skill development	8	1	7	*13%*	*8%*	*14%*
supplemental instruction	14	2	12	*22%*	*15%*	*24%*
experimental design	21	2	19	*33%*	*15%*	*37%*
interdisciplinary learning	1	0	1	*2%*	*0%*	*2%*
cross-disciplinary	2	0	2	*3%*	*0%*	*4%*
active learning	9	3	6	*14%*	*23%*	*12%*
inquiry-based	14	1	13	*22%*	*8%*	*25%*
problem-based	8	0	8	*13%*	*0%*	*16%*
group assignments	4	0	4	*6%*	*0%*	*8%*
critical thinking	45	6	39	*70%*	*46%*	*76%*
problem-solving	28	6	22	*44%*	*46%*	*43%*
conduct research	25	5	20	*39%*	*38%*	*39%*
responsible conduct of research	43	7	36	*67%*	*54%*	*71%*

	Counts			Percentages		
	All MARC grants 2014	High Ph.D. Sender	The Rest (not high Ph.D.)	All MARC grants 2014	High Ph.D. Sender	The Rest (not high Ph.D.)
All MARC Grants 2014	**64**	**13**	**51**	**64**	**13**	**51**
Professional Skills Development	**37**	**12**	**45**	***58%***	***92%***	***88%***
career guidance	7	2	5	*11%*	*15%*	*10%*
service-learning	14	3	11	*22%*	*23%*	*22%*
time management OR stress management	29	5	24	*45%*	*38%*	*47%*
implicit bias	1	0	1	*2%*	*0%*	*2%*
stereotype threat	4	0	4	*6%*	*0%*	*8%*
identity as a scientist	0	0	0	*0%*	*0%*	*0%*
individual development plans	4	2	2	*6%*	*15%*	*4%*
diversity OR inclusion	52	9	43	*81%*	*69%*	*84%*
Faculty Training	**5**	**6**	**15**	***8%***	***46%***	***29%***
faculty training	4	2	2	*6%*	*15%*	*4%*
modalities	3	0	3	*5%*	*0%*	*6%*
pedagogical OR pedagogy	19	6	13	*30%*	*46%*	*25%*
Evaluation	**55**	**11**	**50**	***86%***	***85%***	***98%***
feedback	53	10	43	*83%*	*77%*	*84%*
career development	23	6	17	*36%*	*46%*	*33%*
evaluation	60	11	49	*94%*	*85%*	*96%*
Other	**44**	**11**	**47**	***69%***	***85%***	***92%***
program goal	35	5	30	*55%*	*38%*	*59%*
student publications	6	1	5	*9%*	*8%*	*10%*
student presentations	19	7	12	*30%*	*54%*	*24%*
recruitment criteria	1	0	1	*2%*	*0%*	*2%*
selection criteria	13	4	9	*20%*	*31%*	*18%*
retention strategies	2	0	2	*3%*	*0%*	*4%*
financial support	24	4	20	*38%*	*31%*	*39%*
pipeline	34	3	31	*53%*	*23%*	*61%*

- There is no pattern or correlation of training activities between "High Ph.D. Sender" (>60% trainees into Ph.D. programs) MARC institutions and "The Rest."
- But do see small differences between "High PhD Senders" & "The Rest" in key areas:

	% High PhD Sender	% The Rest
- Student Presentations	54%	24%
- Career Development	46%	33%
- Faculty Training	46%	29%

- Those differences lead us to read the narrative of the text; very informative - e.g., Faculty Training & Pedagogy – either meant Faculty were trained for improved pedagogy or simply that Faculty did pedagogy to students. Increased % of "High PhD Senders" did the former. However, only 30% of all MARC grantees did some form of "faculty training."
- Individual Development Plans (IDPs) is a newer national training activity. Only 6% of all MARC programs do IDPs for students (15% of "High PhD Senders" & 4% of "The Rest").
- Service Learning has ~equal percentages (23% and 22%) between "High Ph.D. Senders" and "The Rest;" however looking into the text of applications allowed us to identify several programs that heavily use this training technique (e.g., a "High PhD sender" school used the term "Service Learning" 32 times in Program Plan portion of the application; suggesting an important activity for that training program).

SUMMARY

There is no correlation between certain training activities and student Ph.D. entrance outcomes; can not determine the *quality* of the training using the IN-SPIRE tool.

However, IN-SPIRE lead us to:
- Determine which areas (such as IDPs or Faculty Training) are underutilized and need to be highlighted in future iterations of the MARC FOA.
- Postulate that there may be context-dependent activities (such as Service Learning for one school or Faculty Pedagogical Training for another) that the "High Ph.D. Senders" use that help their students achieve to have better Ph.D. entrance outcomes than "The Rest."